Predicting Presence of Pneumonia from Images of X-Rays

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Outline

1. Business Problem
2. Data
3. Methods
4. Evaluation Standards
5. Predictive Modeling
6. Conclusions & Further Recommendations
7. Appendix

Business Problem

- Predict Presence of Pneumonia from x-rays
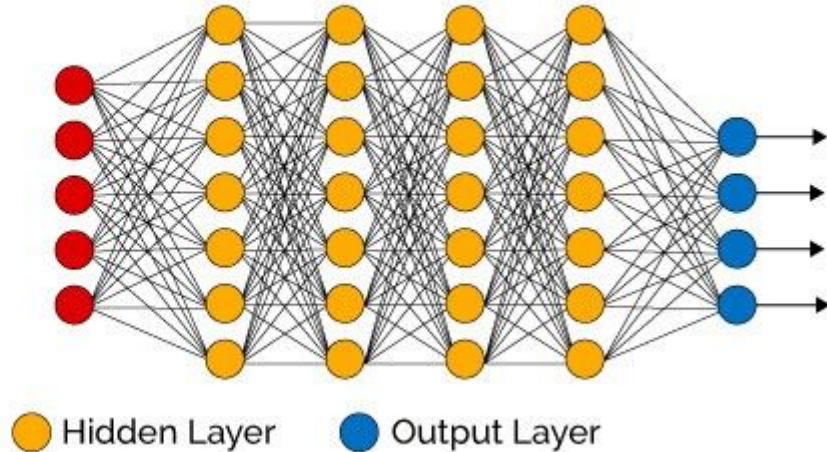- Assist physicians and radiologists
- Create diagnostic software

Data

- 5,800 x-rays
- Bacterial and viral pneumonia
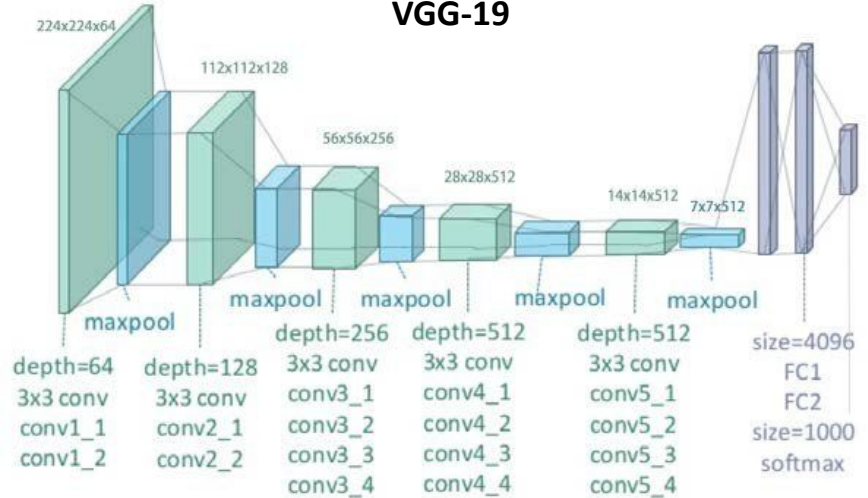 - Lobar consolidation vs. scarring

Normal | Bacterial Pneumonia | Viral Pneumonia

Methods

- Deep Learning
- Convolutional Neural Networks

Deep Learning Neural Network

Hidden Layer   Output Layer

VGG-19

224x224x64

112x112x128

56x56x256

28x28x512

14x14x512

7x7x512

maxpool

maxpool   maxpool   maxpool   maxpool

depth=64   depth=128   depth=256   depth=512   depth=512
3x3 conv   3x3 conv   3x3 conv   3x3 conv   3x3 conv
conv1_1   conv2_1   conv3_1   conv4_1   conv5_1
conv1_2   conv2_2   conv3_2   conv4_2   conv5_2
                     conv3_3   conv4_3   conv5_3
                     conv3_4   conv4_4   conv5_4

size=4096
FC1
FC2
size=1000
softmax

Evaluation Standards

- Common x-ray performance metrics:
    - Sensitivity, specificity, PPV, F1

Source	Metric Type	Value
IBM	Sensitivity	0.720
IBM	Specificity	0.973
IBM	PPV	0.682
Stanford U	F1	0.435

Predictive Modeling

Baseline vs. final model results

Metric Type	Baseline Value	Final Model Value
Sensitivity	0.959	0.877
Specificity	0.632	0.939
PPV	0.813	0.970
F1	0.880	0.920

Legend:
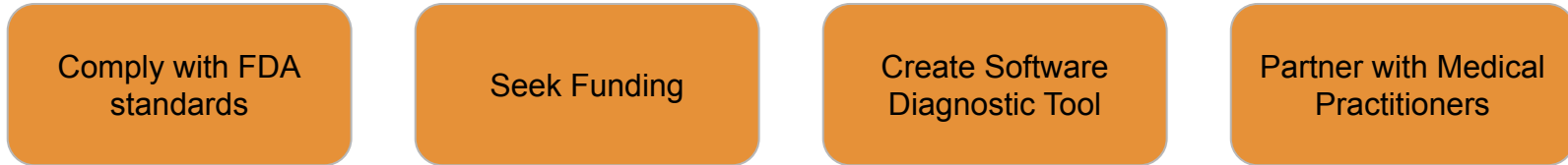<10% worse than standard
>=10% worse than standard
>=10% better than standard

Conclusions & Further Recommendations

Improve the Model:

Standardize the data (image size) → Tune the model → Increase Compute Power → Train on more data
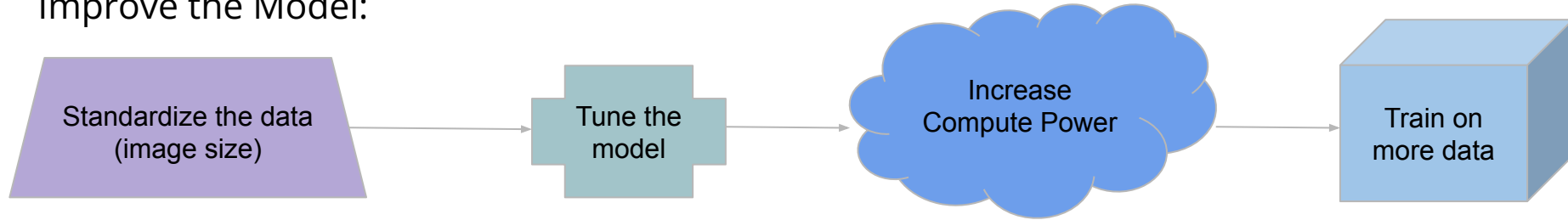
Plans for Implementing Business Solutions:

Comply with FDA standards

Seek Funding

Create Software Diagnostic Tool

Partner with Medical Practitioners

Appendix

Evaluation standard sources:

- https://www.ibm.com/blogs/research/2020/11/ai-x-rays-for-radiologists/
- https://arxiv.org/pdf/1711.05225.pdf

Dataset Source:

- https://www.kaggle.com/datasets/paultimothymooney/chest-xray-pneumonia